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TITLE: ORGANIC THIN FILM EL ELEMENT

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INVENTOR-INFORMATION:
NAME
IKEZU, YUICHI

ASSIGNEE-INFORMATION:

NAME	COUNTRY
NEC CORP	N/A

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ABSTRACT:

PROBLEM TO BE SOLVED: To provide white light without reducing luminous efficiency by providing a layer for emitting blue light by an applied voltage on a transparent substrate, and a green light emitting layer which absorbs a part of the blue light and a red light emitting layer which absorbs a part of the blue and green lights on the other surface of the transparent substrate.

SOLUTION: In this organic thin film EL element, a positive electrode 2 formed of an ITO thin film, a positive hole injection and transport layer 3 formed of P-type ZnS, a blue right emitting layer 4 formed of an oxyazole metal complex, an electron injection transport layer 5 formed of n-type Zn S or the like, and a negative electrode 6 formed of ITO are provided on one surface of a transparent substrate 1. Further, a green light emitting layer 7 formed of naphthaimide derivative coloring matter or the like which absorbs a part of the blue light from a blue light emitting layer 4 and generates green light, and a red light emitting layer 8 formed of cyanin coloring matter or the like which absorbs a part of the blue light and green light and generates red light are provided on the other surface of the base 1. Thus, white light can be provided.

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] the whole surface counters and prepares a blue light in the whole surface of the 1st luminous layer which emits light, and the 1st luminous layer of the above with the impressed voltage -- having -- the above -- a part of blue light -- absorbing -- a green light -- emitting light -- while -- the above -- on the other hand, the 2nd luminous layer of the above resembles the 2nd luminous layer which makes the remainder of a blue light penetrate, and the whole surface prepares -- having -- the above, while absorbing a part of green light and a part of aforementioned blue remaining light and emitting light in a red light In the organic thin film EL element equipped with the 3rd luminous layer which makes the remainder of the light of the aforementioned green, and the remainder of the aforementioned blue remaining light penetrate the above 1st, the 2nd, and 3rd luminous layers The light by which a laminating is carried out in this turn and shell discharge of the 3rd luminous layer of the above is carried out on the other hand is an organic thin film EL element characterized by being the white light.
[Claim 2] It is the organic thin film EL element characterized by being placed between inter-electrode [which impresses the aforementioned voltage] by the 1st luminous layer of the above, constituting the luminescence section in an organic thin film EL element according to claim 1, and constituting the above 2nd and the 3rd luminous layer from an optical transducer by which opposite formation was carried out at the aforementioned luminescence section.
[Claim 3] It is the organic thin film EL element characterized by carrying out opposite formation of the aforementioned luminescence section and the aforementioned optical transducer through a substrate in an organic thin film EL element according to claim 1 or 2.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the organic thin film EL element used for the back light of the color display equipped with the thin film containing an organic compound, a light filter, etc. in detail about an organic thin film electroluminescence (EL) element.
[0002]
[Description of the Prior Art] Conventionally, the organic electroluminescence devices (organic electroluminescent element) shown in JP,7-142169,A are known. Especially organic thin film EL element 50 is equipped with the conventional organic EL element, the anode plate 52 formed on the transparent substrate 51, the hole injection and transporting bed 53 which were formed on it, the luminous layer 54 formed on it, the green luminous layer 55 formed on the luminous layer 54, and the cathode 56 formed on it as shown in drawing 3 . Here, the green luminous layer 55 has a field containing a red fluorochrome.
[0003] Drawing 4 is drawing showing the example of other conventional organic thin film EL elements 60. If drawing 4 is referred to, organic thin film EL element 60 is equipped with the anode plate 52 prepared on the transparent substrate 51, the hole injection and transporting bed 53 which were formed on it, and the luminous layer 54 formed on it, and this luminous layer 54 is constituted by the blue luminous layer 57 arranged at the coplanar, the green luminous layer 58, and the red luminous layer 59.
[0004] An anode plate to an electron hole makes a part for red and the green and blue three primary colors, and a green layer contain a red fluorochrome for the organic luminous layer which carries out excitation luminescence by the energy produced when cathode to an electron is poured in and both carriers recombine, and organic thin film EL elements 50 and 60 shown in drawing 3 and drawing 4 obtain white coloring for them a laminating or by carrying out contiguity arrangement superficially. These organic thin film EL elements 50 and 60 are compared with having the alternating current whose inorganic EL element is 200V, and have the advantage that it can drive by direct current several V.
[0005]
[Problem(s) to be Solved by the Invention] However, in the laminated layers method shown in drawing 3 , since there were many films inserted between an electrode 52 and 53, thickness's increased and luminescence starting potential and current increased, luminous efficiency had the fault of a low. Moreover, since it was a multilayer laminated structure, it had the fault that a manufacturing process was complicated.
[0006] Moreover, by the plane configuration method shown in drawing 4 , since the films 57, 58, and 59 of each luminescent color had to be formed alternatively, it had the fault that a manufacturing process was complicated.
[0007] Then, the technical technical problem of this invention is to offer the organic thin film EL element which can acquire the white light, without reducing luminous efficiency.
[0008]
[Means for Solving the Problem] The 1st luminous layer which emits light in a blue light with the impressed voltage according to this invention, the whole surface counters and prepares in the whole surface of the 1st luminous layer of the above -- having -- the above -- a part of blue light -- absorbing -- a green light -- emitting light -- while -- the above -- with the 2nd luminous layer which makes the remainder of a blue light penetrate on the other hand, the 2nd luminous layer of the above is alike, and the whole surface prepares -- having -- the above, while absorbing a part of green light and a part of aforementioned blue remaining light and emitting light in a red light In the organic thin film EL element equipped with the 3rd luminous layer which makes the remainder of the light of the aforementioned green, and the remainder of the aforementioned blue remaining light penetrate the above 1st, the 2nd, and 3rd luminous layers The organic thin film EL element characterized by the light by which a laminating is carried out in this turn and shell discharge of the 3rd luminous layer of the above is carried out on the other hand being the white light is obtained.
[0009] Moreover, according to this invention, in the aforementioned organic thin film EL element, it is placed between inter-electrode [which impresses the aforementioned voltage] by the 1st luminous layer of the above, it constitutes the luminescence section, and the organic thin film EL element characterized by constituting the above 2nd and the 3rd luminous layer from an optical transducer by which opposite formation was carried out at the aforementioned luminescence section is obtained.
[0010] Furthermore, according to this invention, in the organic thin film EL element of one of the above, the organic thin film

EL element characterized by carrying out opposite formation of the aforementioned luminescence section and the aforementioned optical transducer through a substrate is obtained.

[0011]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

[0012] Drawing 1 is the cross section showing the organic thin film EL element by the gestalt of 1 operation of this invention. The anode plate 2 by which the organic thin film EL element was formed in the whole surface of the transparent substrate 1 with reference to drawing 1 , on the other hand, an anode plate 2 is alike, and the whole surface with the hole injection and the transporting bed 3 joined and formed on the other hand, the hole injection and the transporting bed 3 were alike, and it has the blue luminous layer 4 in which the whole surface was joined and formed, the electron injection and transporting bed 5 in which the blue luminous layer 4 resembled on the other hand, and the whole surface was joined and formed, and the cathode 6 by which the whole surface was joined and formed in the electron injection and the transporting bed 5

[0013] on the other hand -- a transparent substrate -- on the other hand -- being alike -- the whole surface of the green coloring layer 7 joins -- having -- the green coloring layer 7 -- on the other hand -- being alike -- the whole surface of the red coloring layer 8 joins -- having -- the red coloring layer 8 -- on the other hand -- since -- it has composition which emits the white light

[0014] Plastic film, sheets, etc. whose transparent substrates 1 are transparent materials, such as a quartz, a glass plate, polyester usually used as a substrate, a polymethylmethacrylate, a polycarbonate, and the poly ape phone, are used.

[0015] Moreover, it is the indium tin oxide (ITO) which aims at reduction of a hole-injection obstruction, is chosen from a small material of a work function as an anode plate 2, and is generally known as a transparent electrode, and SnO2. Or gold (Au) of about 50nm of thickness can be formed in the whole surface of the transparent substrate 1 by sputtering, the vacuum deposition method, etc.

[0016] Moreover, as cathode 6, reduction of an electron-injection wall is aimed at, it is chosen from a small material of a work function, and an aluminum, silver, nickel, and magnesium-silver alloy etc. can be formed by an application or sputtering, the vacuum deposition method, etc. in the shape of a paste in addition to the above-mentioned indium tin oxide (ITO), SnO2, and gold.

[0017] Moreover, although it is for conveying the electron hole which the hole injection and the transporting bed 3 consisted of material which has light-transmission nature, and was poured in from the anode plate 2 to the blue luminous layer 4 and p type hydrogenation amorphous silicon, P type hydrogenation amorphous carbonization silicon, p type zinc sulfide, and p type zinc selenide can be used as the material, these are formed of dry membrane formation of a vacuum deposition method, CVD, a plasma CVD method, a spatter, etc.

[0018] in addition, as a material of other hole injection and transporting beds 3 Well-known N, N-diphenyl - N, N'-(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine;1, and 1-screw (4-G p-tolylamino phenyl) cyclohexane; Aroma group amine system compounds, such as 4 and a 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl, Although a hydrazone compound, a silazane compound, a Quinacridone compound, etc. can be used, polymeric materials, such as a polyvinyl carbazole and polysilane, can be used. such material -- binders, such as a polycarbonate, a polyacrylate, and polyester, -- ** -- although both formed [after dissolving in the organic solvent] by carrying out application dryness, organic materials other than polymeric materials can be formed by dry membrane formation as well as the above-mentioned inorganic material

[0019] The blue luminous layer 4 is what carries out blue luminescence for the energy emitted by the reunion of the electron hole conveyed through the hole injection and the transporting bed 3 from the anode plate 2, and the electron poured in through the electron injection and the transporting bed 5 from cathode 6. As a material of this blue luminous layer 4 The OKISAZARU metal complex shown in ** and ** 1 formula of JP,7-142169,A, the JISUCHIRIRU benzene derivative shown in ** 2 formula of this official report, the styryl amine content polycarbonate shown in this official report, the OKISA diazole derivative shown in said official report-ized 3 formulas, The aluminum complex shown in ** 5 formula of the OKISA diazole derivative shown in ** 4 formula of this official report, the azomethine zinc complex shown in this official report, and this official report and ** 6 formula can be used, and it is also possible to dope a blue fluorochrome if needed.

[0020] Moreover, stilbene compounds, such as 1, 4-screw (4-ethyl styryl) benzene, 1, 4-screw (2-methyl styryl) benzene, 1, and 4-screw (2 and 2-G p-tolyl vinyl) benzene, can be used as shown in JP,3-152897,A.

[0021] Moreover, the green coloring layer 7 is excited from a blue luminous layer to blue luminescence, and although it can mention metal complexes, such as an aluminum complex of well-known 8-hydroxyquinoline shown in JP,3-152897,A, a NAFUTARU imide derivative, a thia JIAJIAZORO pyridine derivative, a pyrrolo pyridine derivative, a NAFUCHI lysine derivative, etc. as the material including the coloring matter which emits light in green, it can also dope a coumarin system green fluorochrome.

[0022] The red luminous layer 8 consists of coloring matter which absorbs green and emits light in red. furthermore, as the material JISHIANIN system coloring matter [, such as a 4-dicyanomethylene-2 methyl-6-(p-dimethylamino still phosphorus)-4H-pyran (DCM),]; given in JP,3-152897,A -- 1-ethyl-2- (4-(p-dimethylamino phenyl)-1 --) 3-swine dienyl-pilus JIUMU-par colla tempestade REITO Equal thing pyridine system coloring matter; (Pyridine 1) Coumarin coloring matter, an acridine dye, other fused aromatic ring coloring matter, for example, phenoxazone, and phenoxazone group 660 grade can be used as illustrated by xanthene dye [, such as Rhodamine B and rhodamine 6G,]; etc. at an oxazine system and JP,7-142169,A.

[0023] Moreover, n type zinc sulfide, n type zinc selenide, etc. are mentioned among well-known n- type hydrogenation amorphous-as electron-injection and transporting bed 5 silicon. Furthermore, the compound shown by ** 7 formula of

JP,7-142169,A and ** 8 formula can also be used.
[0024] The organic thin film EL element shown in drawing 1 to the transparent substrate 1 by the spatter An ITO thin film is formed and they are N and N'-diphenyl on it further. - N, the N'-screw (alpha-naphthyl) -1, the 1'-biphenyl -4, and a 4'-diamine (it is called alpha-NPD) are formed by the vacuum deposition. on it by the vacuum deposition method PESB (the vacuum evaporationo of the 1 and 4-screw (4-ethyl styryl) benzene was carried out, further, the aluminum quinoline was formed by the vacuum deposition method as an electron-injection layer on it, and the magnesium-silver-alloy thin film was formed as cathode 6 by the vacuum deposition method on it.) moreover, on the other hand, the transparent substrate 1 was alike, resin mixture of a coumarin and the red luminous layer (DCM) was carried out as a green luminous layer, respectively, and it formed by an application and dryness
[0025] Drawing 2 is the cross section showing the organic thin film EL element by the gestalt of operation of the 2nd of this invention. With reference to drawing 2 , the organic thin film EL element by the gestalt of the 2nd operation The red coloring layer 8 formed on the transparent substrate 1, and the green coloring layer 7 formed on the red coloring layer 8, It has the hole injection and the transporting bed 3 formed on the anode plate 2 and the anode plate 2 as having been formed on the green coloring layer 7, the blue luminous layer 4 formed on the hole injection and the transporting bed 3, the electron injection and transporting bed 5 which were formed on the blue luminous layer 4, and the cathode 6 formed on the electron injection and the transporting bed 5.
[0026] The organic thin film EL element by the gestalt of the 2nd operation differs from the gestalt of the 1st operation the following point. Namely, the organic thin film EL elements by the gestalt of the 2nd operation differ inside a substrate to laminating formation of the green coloring layer 7 and the red coloring layer 8 being carried out at the superficies of a substrate, as for the organic thin film EL element by the gestalt of the 1st operation in that laminating formation of the green coloring layer 7 and the red coloring layer 8 is carried out. The class material by the gestalt of the 2nd operation is the same as that of the gestalt of the 1st operation.
[0027] In the gestalt of 1 operation of this invention, the layer which carries out excitation luminescence by the recombination energy of an electron hole/electron The layer which absorbs a blue light energy to the field where the side in which makes only a blue luminous layer with the highest energy, and this blue glow carries out outgoing radiation was separated electrically, and emits light green to it, Since it is formed by carrying out the laminating of the layer which absorbs the light energy of green - blue and emits light in red to order, energy efficiency can be raised.
[0028]
[Effect of the Invention] As mentioned above, although according to this invention luminescence by EL which needs electrical energy is only a blue luminous layer, and this coloring matter becomes the trap of energy in one EL layer as a dopant when [each] coloring matter addition is carried out since other colors emit light by PL as explained, as compared with this, the organic thin film EL element to which luminous efficiency is not reduced can be offered.

[Translation done.]

MEANS

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[0009] Moreover, according to this invention, in the aforementioned organic thin film EL element, it is placed between inter-electrode [which impresses the aforementioned voltage] by the 1st luminous layer of the above, it constitutes the luminescence section, and the organic thin film EL element characterized by constituting the above 2nd and the 3rd luminous layer from an optical transducer by which opposite formation was carried out at the aforementioned luminescence section is obtained.

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[0017] Moreover, although it is for conveying the electron hole which the hole injection and the transporting bed 3 consisted of material which has light-transmission nature, and was poured in from the anode plate 2 to the blue luminous layer 4 and p type hydrogenation amorphous silicon, P type hydrogenation amorphous carbonization silicon, p type zinc sulfide, and p type zinc selenide can be used as the material, these are formed of dry membrane formation of a vacuum deposition method, CVD, a plasma CVD method, a spatter, etc.

[0018] in addition, as a material of other hole injection and transporting beds 3 Well-known N, N-diphenyl - N, N'-(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine;1, and 1-screw (4-G p-tolylamino phenyl) cyclohexane; Aroma group amine system compounds, such as 4 and a 4'-screw (N-(1-naphthyl)-N-phenylamino) biphenyl, Although a hydrazone compound, a

silazane compound, a Quinacridone compound, etc. can be used, polymeric materials, such as a polyvinyl carbazole and polysilane, can be used. such material -- binders, such as a polycarbonate, a polyacrylate, and polyester, -- ** -- although both formed | after dissolving in the organic solvent | by carrying out application dryness, organic materials other than polymeric materials can be formed by dry membrane formation as well as the above-mentioned inorganic material

[0019] The blue luminous layer 4 is what carries out blue luminescence for the energy emitted by the reunion of the electron hole conveyed through the hole injection and the transporting bed 3 from the anode plate 2, and the electron poured in through the electron injection and the transporting bed 5 from cathode 6. As a material of this blue luminous layer 4 The OKISAZARU metal complex shown in ** and ** 1 formula of JP,7-142169,A, the JISUCHIRIRU benzene derivative shown in ** 2 formula of this official report, the styryl amine content polycarbonate shown in this official report, the OKISA diazole derivative shown in said official report-ized 3 formulas, The aluminum complex shown in ** 5 formula of the OKISA diazole derivative shown in ** 4 formula of this official report, the azomethine zinc complex shown in this official report, and this official report and ** 6 formula can be used, and it is also possible to dope a blue fluorochrome if needed.

[0020] Moreover, stilbene compounds, such as 1, 4-screw (4-ethyl styryl) benzene, 1, 4-screw (2-methyl styryl) benzene, 1, and 4-screw (2 and 2-G p-tolyl vinyl) benzene, can be used as shown in JP,3-152897,A.

[0021] Moreover, the green coloring layer 7 is excited from a blue luminous layer to blue luminescence, and although it can mention metal complexes, such as an aluminum complex of well-known 8-hydroxyquinoline shown in JP,3-152897,A, a NAFUTARU imide derivative, a thia JIAJIAZORO pyridine derivative, a pyrrolo pyridine derivative, a NAFUCHI lysine derivative, etc. as the material including the coloring matter which emits light in green, it can also dope a coumarin system green fluorochrome.

[0022] The red luminous layer 8 consists of coloring matter which absorbs green and emits light in red. furthermore, as the material JISHIANIN system coloring matter [, such as a 4-dicyanomethylene-2 methyl-6-(p-dimethylamino still phosphorus)-4H-pyran (DCM),]; given in JP,3-152897,A -- 1-ethyl-2- (4-(p-dimethylamino phenyl)-1 --) 3-swine dienyl-pilus JIUMU-par colla tempestade REITO Equal thing pyridine system coloring matter; (Pyridine 1) Coumarin coloring matter, an acridine dye, other fused aromatic ring coloring matter, for example, phenoxazone, and phenoxazone group 660 grade can be used as illustrated by xanthene dye [, such as Rhodamine B and rhodamine 6G,]; etc. at an oxazine system and JP,7-142169,A.

[0023] Moreover, n type zinc sulfide, n type zinc selenide, etc. are mentioned among well-known n- type hydrogenation amorphous-as electron-injection and transporting bed 5 silicon. Furthermore, the compound shown by ** 7 formula of JP,7-142169,A and ** 8 formula can also be used.

[0024] The organic thin film EL element shown in drawing 1 to the transparent substrate 1 by the spatter An ITO thin film is formed and they are N and N'-diphenyl on it further. - N, the N'-screw (alpha-naphthyl) -1, the 1'-biphenyl -4, and a 4'-diamine (it is called alpha-NPD) are formed by the vacuum deposition. on it by the vacuum deposition method PESB (the vacuum evaporationo of the 1 and 4-screw (4-ethyl styryl) benzene was carried out, further, the aluminum quinoline was formed by the vacuum deposition method as an electron-injection layer on it, and the magnesium-silver-alloy thin film was formed as cathode 6 by the vacuum deposition method on it.) moreover, on the other hand, the transparent substrate 1 was alike, resin mixture of a coumarin and the red luminous layer (DCM) was carried out as a green luminous layer, respectively, and it formed by an application and dryness

[0025] Drawing 2 is the cross section showing the organic thin film EL element by the gestalt of operation of the 2nd of this invention. With reference to drawing 2 , the organic thin film EL element by the gestalt of the 2nd operation The red coloring layer 8 formed on the transparent substrate 1, and the green coloring layer 7 formed on the red coloring layer 8, It has the hole injection and the transporting bed 3 formed on the anode plate 2 and the anode plate 2 as having been formed on the green coloring layer 7, the blue luminous layer 4 formed on the hole injection and the transporting bed 3, the electron injection and transporting bed 5 which were formed on the blue luminous layer 4, and the cathode 6 formed on the electron injection and the transporting bed 5.

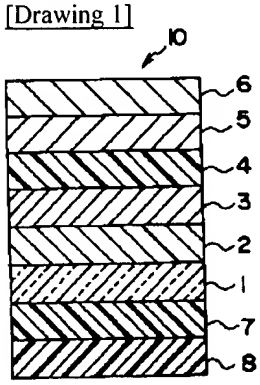
[0026] The organic thin film EL element by the gestalt of the 2nd operation differs from the gestalt of the 1st operation the following point. Namely, the organic thin film EL elements by the gestalt of the 2nd operation differ inside a substrate to laminating formation of the green coloring layer 7 and the red coloring layer 8 being carried out at the superficies of a substrate, as for the organic thin film EL element by the gestalt of the 1st operation in that laminating formation of the green coloring layer 7 and the red coloring layer 8 is carried out. The class material by the gestalt of the 2nd operation is the same as that of the gestalt of the 1st operation.

[0027] In the gestalt of 1 operation of this invention, the layer which carries out excitation luminescence by the recombination energy of an electron hole/electron The layer which absorbs a blue light energy to the field where the side in which makes only a blue luminous layer with the highest energy, and this blue glow carries out outgoing radiation was separated electrically, and emits light green to it, Since it is formed by carrying out the laminating of the layer which absorbs the light energy of green - blue and emits light in red to order, energy efficiency can be raised.

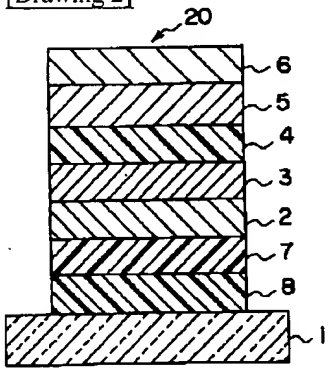
[Translation done.]

DRAWINGS

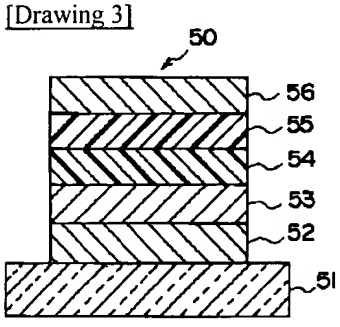
[Drawing 1]



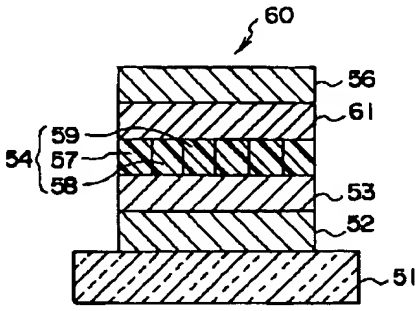
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross section showing the organic thin film EL element by the gestalt of operation of the 1st of this invention.
[Drawing 2] It is the cross section showing the organic thin film EL element by the gestalt of operation of the 2nd of this invention.
[Drawing 3] It is the cross section showing the organic thin film EL element by the conventional technology 1.
[Drawing 4] It is the cross section showing the organic thin film EL element by the conventional technology 2.
[Description of Notations]
1 Transparent Substrate
2 Anode Plate
3 Hole Injection and Transporting Bed
4 Blue Luminous Layer
5 Electron Injection and Transporting Bed
6 Cathode
7 Green Coloring Layer
8 Red Coloring Layer
50 Organic Thin Film EL Element
51 Transparent Sheet Metal
52 Anode Plate
53 Hole Injection and Transporting Bed
54 Luminous Layer
55 Green Luminous Layer
56 Cathode
57 Blue Luminous Layer
58 Green Luminous Layer
59 Red Luminous Layer
60 Organic Thin Film EL Element

[Translation done.]

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(71)出願人　000004237
日本電気株式会社
東京都港区芝五丁目７番１号

(72)発明者　池津　勇一
東京都港区芝五丁目７番１号　日本電気株式会社内

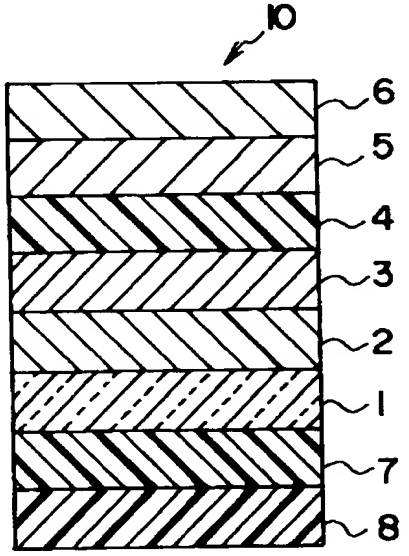
(74)代理人　弁理士　後藤　洋介　（外２名）

(54)【発明の名称】　有機薄膜ＥＬ素子

(57)【要約】

【課題】　発光効率を低下させることなく，白色光を得ることができる有機薄膜ＥＬ素子を提供する。

【解決手段】　印加された電圧によって青色の光を発光する発光層を備えた第１の発光層と，前記第１の発光層の一面に一面が重合わされて設けられ，前記青色の光の一部を吸収して緑色の光の発光するとともに，前記青色の光の残りを透過させる第２の発光層と，一面が前記第２の発光層の他面に設けられ，前記青色の光の残りの一部と前記緑色の光の一部とを吸収して赤色の光を発光するとともに，前記緑色の光の残りと前記残りの青色の光の残りとを透過させる第３の発光層とを備えた有機薄膜ＥＬ素子において，前記第１，第２，及び第３の発光層は，この順番で重ね合わされ，前記第１の発光層の他面から放出される光は白色光である。



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【特許請求の範囲】

【請求項1】　印加された電圧によって青色の光を発光する第1の発光層と，前記第1の発光層の一面に一面が対向して設けられ，前記青色の光の一部を吸収して緑色の光の発光するとともに前記青色の光の残りを透過させる第2の発光層と，一面が前記第2の発光層の他面に設けられ，前記緑色の光の一部と前記残りの青色の光の一部とを吸収して赤色の光を発光するとともに前記緑色の光の残りと前記残りの青色の光の残りを透過させる第3の発光層とを備えた有機薄膜ＥＬ素子において，前記第1，第2，及び第3の発光層は，この順番で積層され，前記第3の発光層の他面から放出される光は白色光であることを特徴とする有機薄膜ＥＬ素子。

【請求項2】　請求項1記載の有機薄膜ＥＬ素子において，前記第1の発光層は，前記電圧を印加する電極間に介在して発光部を構成し，前記第2及び第3の発光層は，前記発光部に対向形成された光変換部で構成することを特徴とする有機薄膜ＥＬ素子。

【請求項3】　請求項1又は2記載の有機薄膜ＥＬ素子において，前記発光部と前記光変換部とは，基板を介して対向形成されていることを特徴とする有機薄膜ＥＬ素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は，有機薄膜エレクトロルミネッセンス（ＥＬ）素子に関し，詳しくは，有機化合物を含む薄膜を備えたカラーディスプレイのバックライト，カラーフィルタ等に用いられる有機薄膜ＥＬ素子に関する。

【０００２】

【従来の技術】従来，特開平７－１４２１６９号に示された有機電界発光素子（有機エレクトロルミネッセンス素子）が知られている。従来の有機ＥＬ素子，特に，有機薄膜ＥＬ素子５０は，図３に示すように，透明基板５１上に形成された陽極５２と，その上に形成された正孔注入・輸送層５３と，その上に形成された発光層５４と，発光層５４上に形成された緑色発光層５５と，その上に形成された陰極５６とを備えている。ここで，緑色発光層５５は，赤色蛍光色素を含有する領域を有する。

【０００３】図４は従来の他の有機薄膜ＥＬ素子６０の例を示す図である。図４を参照すると，有機薄膜ＥＬ素子６０は透明基板５１上に設けられた陽極５２と，その上に形成された正孔注入・輸送層５３と，その上に形成された発光層５４を備え，この発光層５４は，同一平面上に配置された青色発光層５７，緑色発光層５８，及び赤色発光層５９とによって構成されている。

【０００４】図３及び図４に示す有機薄膜ＥＬ素子５０，６０は，陽極から正孔が，陰極から電子が注入され，双方のキャリアが再結合することによって生じるエネルギーによって，励起発光する有機発光層を赤色，緑色，青色の３原色分もしくは緑色層に赤色蛍光色素を含有させ，それらを積層もしくは平面的に隣接配置することにより白色発色を得るものである。この有機薄膜ＥＬ素子５０，６０は，無機ＥＬ素子が２００Ｖの交流を有するに比べて，直流で数Ｖで駆動できるという利点を有している。

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【０００５】

【発明が解決しようとする課題】しかしながら，図３に示す積層法では，電極５２及び５３間に挿入される膜数が多く，膜厚も増えるので，発光開始電圧・電流が増加するため，発光効率が低いという欠点を有した。また，多層積層構造であるため，製造工程が複雑であるという欠点を有した。

【０００６】また，図４に示す平面配置法では，それぞれの発光色の膜５７，５８，及び５９を選択的に形成しなければならないので製造工程が複雑であるという欠点を有した。

【０００７】そこで，本発明の技術的課題は，発光効率を低下させることなく，白色光を得ることができる有機薄膜ＥＬ素子を提供することにある。

【０００８】

【課題を解決するための手段】本発明によれば，印加された電圧によって青色の光を発光する第1の発光層と，前記第1の発光層の一面に一面が対向して設けられ，前記青色の光の一部を吸収して緑色の光の発光するとともに前記青色の光の残りを透過させる第2の発光層と，一面が前記第2の発光層の他面に設けられ，前記緑色の光の一部と前記残りの青色の光の一部とを吸収して赤色の光を発光するとともに前記緑色の光の残りと前記残りの青色の光の残りを透過させる第3の発光層とを備えた有機薄膜ＥＬ素子において，前記第1，第2，及び第3の発光層は，この順番で積層され，前記第3の発光層の他面から放出される光は白色光であることを特徴とする有機薄膜ＥＬ素子が得られる。

【０００９】また，本発明によれば，前記有機薄膜ＥＬ素子において，前記第1の発光層は，前記電圧を印加する電極間に介在して発光部を構成し，前記第2及び第3の発光層は，前記発光部に対向形成された光変換部で構成することを特徴とする有機薄膜ＥＬ素子が得られる。

【００１０】さらに，本発明によれば，前記いずれかの有機薄膜ＥＬ素子において，前記発光部と前記光変換部とは，基板を介して対向形成されていることを特徴とする有機薄膜ＥＬ素子が得られる。

【００１１】

【発明の実施の形態】以下，本発明の実施の形態について図面を参照して説明する。

【００１２】図１は本発明の一実施の形態による有機薄膜ＥＬ素子を示す断面図である。図１を参照して，有機薄膜ＥＬ素子は，透明基板１の一面に形成された陽極２と，陽極２の他面に一面が接合されて形成された正孔注

入・輸送層3と，正孔注入・輸送層3の他面に一面が接合されて形成された青色発光層4と，青色発光層4の他面に一面が接合されて形成された電子注入・輸送層5と，電子注入・輸送層5に一面が接合されて形成された陰極6とを備えている。

【0013】一方，透明基板の他面には，緑色発色層7の一面が接合され，緑色発色層7の他面には，赤色発色層8の一面が接合され，赤色発色層8の他面から白色光を放出する構成となっている。

【0014】透明基板1は透明材料である石英，ガラス板，通常基板として用いられるポリエステル，ポリメチルメタクリレート，ポリカーボネート，ポリサルホン等のプラスチックフィルムやシート等が用いられる。

【0015】また，陽極2としては，正孔注入障壁の低減を狙って，仕事関数の小さい材料から選択され，一般的に透明電極として知られるインジウムチンオキサイド（ＩＴＯ），SnO_2 もしくは，膜厚５０ｎｍ程度の金（Ａｕ）をスパッタリング，真空蒸着法等によって透明基板１の一面に形成することができる。

【0016】また，陰極6としては，電子注入壁の低減を狙って，仕事関数の小さい材料から選択され，前述のインジウムチンオキサイド（ＩＴＯ），SnO_2 ，金以外に，アルミニウム，銀，ニッケル，マグネシウム－銀合金等をペースト状に塗布あるいは，スパッタリング，真空蒸着法等によって形成することができる。

【0017】また，正孔注入・輸送層3は，光透過性を有する材料からなり，陽極2から注入された正孔を青色発光層4に輸送するためのものであり，その材料としては，ｐ型水素化非晶質シリコン，Ｐ型水素化非晶質炭化シリコン，ｐ型硫化亜鉛，ｐ型セレン化亜鉛を用いることができるが，これらは，真空蒸着法，ＣＶＤ法，プラズマＣＶＤ法，スパッタ法等のドライ成膜により形成される。

【0018】尚，他の正孔注入・輸送層3の材料としては，公知のＮ，Ｎ－ジフェニル－Ｎ，Ｎ´－（３－メチルフェニル）－１，１´－ビフェニール－４，４´－ジアミン；１，１－ビス（４－ジ－ｐ－トリルアミノフェニル）シクロヘキサン；４，４´－ビス（Ｎ－（１－ナフチル）－Ｎ－フェニルアミノ）ビフェニル等の芳香属アミン系化合物，ヒドラゾン化合物，シラザン化合物，キナクリドン化合物，などを用いることができるが，ポリビニルカルバゾルやポリシラン等の高分子材料を用いることができる。これらの材料は，ポリカーボネート，ポリアクリレート，ポリエステル等のバインダーとともに，有機溶剤に溶解後，塗布乾燥することによって形成されるが，高分子材料以外の有機材料は，前述の無機材料と同様に，ドライ成膜によっても形成することができる。

【0019】青色発光層4は，陽極2から正孔注入・輸送層3を介して輸送された正孔と，陰極6から電子注入

・輸送層5を介して注入された電子との再結合によって放出されるエネルギーを青色の発光をするもので，この青色発光層4の材料としては，特開平７－１４２１６９号公報の化１式に示されるオキサザール金属錯体，同公報の化２式に示されるジスチリルベンゼン誘導体，同公報に示されるスチリルアミン含有ポリカーボネート，同公報化３式に示されるオキサジアゾール誘導体，同公報の化４式に示されるオキサジアゾール誘導体，同公報に示されるアゾメチン亜鉛錯体，同公報の化５式及び化６式に示されるアルミニウム錯体を用いることができ，必要に応じて，青色蛍光色素をドープすることも可能である。

【0020】また，特開平３－１５２８９７号公報に示されているように，１，４－ビス（４－エチルスチリル）ベンゼン，１，４－ビス（２－メチル　スチリル）ベンゼン，１，４－ビス（２，２－ジ－ｐ－トリルビニル）ベンゼン等のスチルベン化合物を用いることができる。

【0021】また，緑色発色層7は，青色発光層からの青色の発光に励起され，緑色を発光する色素を含み，その材料としては，特開平３－１５２８９７号公報に示された公知の８－ヒドロキシキノリンのアルミニウム錯体等の金属錯体，ナフタルイミド誘導体，チアジアジアゾロピリジン誘導体，ピロロピリジン誘導体，ナフチリジン誘導体等を挙げることができるが，クマリン系緑色蛍光色素をドープすることもできる。

【0022】さらに，赤色発光層8は，緑色を吸収して赤色を発光する色素からなり，その材料としては，特開平３－１５２８９７号公報に記載の４－ジシアノメチレン－２メチル－６－（ｐ－ジメチルアミノスチルリン）－４Ｈ－ピラン（ＤＣＭ）等のジシアニン系色素；１－エチル－２－（４－（ｐ－ジメチルアミノフェニル）－１，３－ブタジエニル）－ピリジウム－パーコラレイト（ピリジン１）等しいのピリジン系色素；ローダミンＢ，ローダミン６Ｇ等のキサンテン系色素；他にオキサジン系や，特開平７－１４２１６９号公報に例示されている通り，クマリン色素，アクリジン色素，その他の縮合芳香族環色素，例えば，フェノキサゾン，フェノキサゾン族６６０等が使用できうる。

【0023】また，電子注入・輸送層5としては，公知のｎ－型水素化非晶質シリコンなか，ｎ型硫化亜鉛，ｎ型セレン化亜鉛等が挙げられる。さらには，特開平７－１４２１６９号公報の化７式及び化８式で示される化合物も使用することができる。

【0024】図１に示す有機薄膜ＥＬ素子は，透明基板１にスパッタによりＩＴＯ薄膜を形成し，さらにその上に，Ｎ，Ｎ´－ジフェニル－Ｎ，Ｎ´－ビス（α－ナフチル）－１，１´－ビフェニル－４，４´－ジアミン（α－ＮＰＤと呼ぶ）を蒸着法によって形成し，その上に真空蒸着法により，ＰＥＳＢ（１，４－ビス（４－エ

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チルスチリル）ベンゼンを蒸着し，さらに，その上に電子注入層としてアルミキノリンを真空蒸着法で形成し，その上に，真空蒸着法により陰極6としてマグネシウム－銀合金薄膜を形成した。また，透明基板1の他面に，緑色発光層としてクマリン及び赤色発光層（DCM）を夫々樹脂混合して，塗布，乾燥によって形成した。

【0025】図2は本発明の第2の実施の形態による有機薄膜EL素子を示す断面図である。図2を参照して，第2の実施の形態による有機薄膜EL素子は，透明基板1上に形成された赤色発色層8と，赤色発色層8上に形成された緑色発色層7と，緑色発色層7上に形成されたと陽極2と，陽極2上に形成された正孔注入・輸送層3と，正孔注入・輸送層3上に形成された青色発光層4と，青色発光層4上に形成された電子注入・輸送層5と，電子注入・輸送層5上に形成された陰極6とを備えている。

【0026】第2の実施の形態による有機薄膜EL素子は，第1の実施の形態とは，次の点で異なっている。即ち，第1の実施の形態による有機薄膜EL素子は，基板の外面に緑色発色層7と，赤色発色層8とが積層形成されているのに対して，第2の実施の形態による有機薄膜EL素子は，基板の内側に，緑色発色層7と，赤色発色層8とが積層形成されている点で異なる。第2の実施の形態による各層材料は，第1の実施の形態と同様である。

【0027】本発明の一実施の形態においては，正孔／電子の再結合エネルギーで励起発光する層は，最もエネルギーの高い青色発光層のみとし，この青色光が出射する側の電気的には分離された面に青色の光エネルギーを吸収して緑色に発光する層と，緑～青色の光エネルギーを吸収して赤色に発光する層とを順に積層することによって形成されているので，エネルギー効率を高めることができる。

【0028】

【発明の効果】以上，説明したように，本発明によれば，電気エネルギーを必要とするELによる発光は，青色発光層のみで，他の色はPLによって発光するので，一つのEL層にドーパントとして夫々の色素添加した場合に，この色素がエネルギーのトラップになるが，これに比較して，発光効率を低下させることがない有機薄膜EL素子を提供することができる。

【図面の簡単な説明】

【図1】本発明の第1の実施の形態による有機薄膜EL素子を示す断面図である。

【図2】本発明の第2の実施の形態による有機薄膜EL素子を示す断面図である。

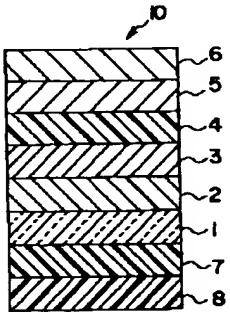
【図3】従来技術1による有機薄膜EL素子を示す断面図である。

【図4】従来技術2による有機薄膜EL素子を示す断面図である。

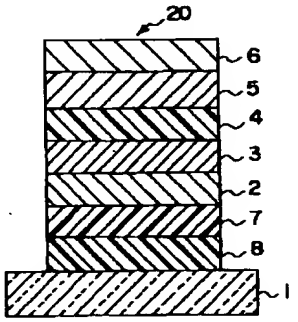
【符号の説明】

1　透明基板
2　陽極
3　正孔注入・輸送層
4　青色発光層
5　電子注入・輸送層
6　陰極
7　緑色発色層
8　赤色発色層
50　有機薄膜EL素子
51　透明薄板
52　陽極
53　正孔注入・輸送層
54　発光層
55　緑色発光層
56　陰極
57　青色発光層
58　緑色発光層
59　赤色発光層
60　有機薄膜EL素子

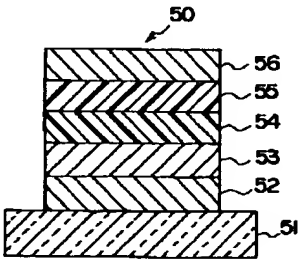
【図1】



【図2】



【図3】



【図4】